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An automated management information system concept for US Air Force food service operations in appropriated fund dining facilities was developed and evaluated. The proposed system concept uses a modern microprocessor located at the food service staff office and linked to peripheral devices such as cash registers and electronic data terminals in the dining facilites to permit real-time data acquisition and processing. (Continued)

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20. Abstract (Continued)

The system concept is designed to enable Air Force base food service personnel to exercise more effective managerial controls by removing the need to perform necessary but routine and burdensome data recording and manipulation manually. The concept was evaluated in a six month test at Seymour Johnson Air Force Base in North Carolina. The results showed that the concept is effective in reducing potential sources of fraud and waste in food service management.

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AN AUTOMATED INFORMATION SYSTEM FOR AIR FORCE FOOD SERVICE OPERATIONS

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UNITED STATES ARMY NATICK
RESEARCH & DEVELOPMENT CENTER
NATICK, MASSACHUSETTS 01760

DIRECTORATE FOR SYSTEMS
ANALYSIS AND CONCEPT DEVELOPMENT

SUMMARY

Comprehensive audits of military food service operations by the Defense Audit Service as well as the General Accounting Office (GAO) have indicated that tens of millions of dollars and possibly as much as 100 million dollars are lost each year through a lack of appropriate management and control mechanisms in the operation of military dining halls. In response to these revelations, the Department of Defense tasked the individual services to address the shortcomings identified in these audit reports, particularly by developing appropriate automated management and control systems for food service operations. A number of the services turned to the US Army Natick R&D Center's Directorate for Systems Analysis and Concept Development to develop these needed systems.

An experimental prototype of an Automated Food Service Operations System (AFSOS) was developed by the Natick R&D Center for the Air Force. This system is designed not only to automate the many time-consuming calculations and report preparation procedures that burden the military food service staff, but, even more importantly, it will tighten the controls on inventory utilization and accountability and on the validation of the identities of those entitled to subsist at government expense, while providing the management information necessary for a well run operation.

The AFSOS system is being welcomed by Air Force food service personnel, as it will perform the routine accounting that exists with any food service operation but which is especially prevalent in the military. Therefore, food service reports and documents currently consuming a considerable amount of time and manual preparation are now being computer-generated. The ability to perform this function was the happy result of the successful integration of the data acquisition capabilities of the electronic cash registers and the magnetic stripe card readers with the microcomputer.

Development of the automated system required that seven separate food service related functions be analyzed and interactive automated system modules be created, coded, and validated. These modules carry out the functions of forecasting, menu production, credit customer verification, inventory control and ordering, accounting, and report preparation and retention procedures. The system is designed to operate in the new generation of Air Force a la carte dining facilities in which cash customers pay by the item for food selected. As a result, the microcomputer is linked in real time to associated electronic cash registers and magnetic stripe card readers on the serving line. These electronic cash registers and card readers provide information regarding which food items have been sold and how much money has been collected from cash customers. The registers also receive information on whether patrons presenting their magnetic stripe military ID card are, in fact, entitled to receive their meals at the government's expense. Further, electronic data terminals have been located in each of the dining facilities and linked to the microcomputer housed in the food service office, thereby permitting a number of different dining halls to utilize the capabilities of the microcomputer to assist in their operations. Aside from the careful control of cash collections and the verification of entitlement to subsist at

government expense, AFSOS also provides for extremely tight controls over the utilization of expensive food product inventories, not only from the point of view of inventory shrinkage through theft, but also by more closely matching the amount of food prepared to the demand for the product. Forecasting algorithms were developed not only for the number of patrons that may be expected at each meal and at each dining facility, but also for the relative numbers of these patrons that will choose the various items being offered. This projection is used to forecast the required number of servings of each item on the menu and the requirements for raw food products needed to prepare the meals. Also, the inventory level is adjusted based upon how much product has been issued for meal preparation as well as how much has been received from vendors and military commissaries, and the computer automatically issues requests for the purchase of more raw food items for the dining hall. Finally, physical inventory forms for use by cooks to perform physical checks of the inventory in hand are produced so that the computer data base can be verified. This integration of all aspects of military food service--from customer identification all the way through the meal preparation to the dining accounting facility -- considerably reduces the cost of operation in military food service.

An Automated Food Service Operations System (AFSOS) technology demonstrator was tested for the Air Force. Results confirmed that the system concept resulted in total annual monetary savings of $104,874 by tightening access and inventory control procedures, by producing legible, accurate audit trails, and by increasing the productivity of managers by allowing them to spend more time supervising and less time (18% in some instances) completing paperwork. Two of the major sources of fraud and waste reduced at the test site were: questionable signature sheet entries and inaccurate records from 23% to 1% and inventory irregularities that reduced overall inventory levels from 12K to 10K. Furthermore, the test was so successful that the Air Force has taken immediate steps to incorporate the system concept directly into the worldwide Services Information Management System. This system has brought the benefits to the computer revolution to the dining hall and will bring Air Force food service operations into the 1980's.

PREFACE

The Directorate for Systems Analysis and Concept Development (DSACD) at the US Army Natick Research and Development Center (NRDC) was tasked with Joint Service Requirement (JSR) AFMN 81-21 Appendix I to develop an Automated Food Service Operations System (AFSOS) for US Air Force food services primarily to assist the Air Force in meeting a DoD tasking in response to a recommendation from the Defense Audit Service that an automated military food accountability and control system be developed.

The Automated Food Service Operations System (AFSOS) was developed and tested with the efforts of a team drawn from various elements of the US Army Natick Research and Development Center (NRDC).

The members of the Natick R&D Center AFSOS Team consisted of Mr. Theodore Mattus, Mr. Paul Peter, Ms. Eilen True, Mr. Steve Taschereau, Mr. Jeffery Hopkins, Ms. Teresa Thanos, Mr. Dave Clark, and Ms. Jane Benson in the Directorate for Systems Analysis and Concept Development as well as Ms. Margaret Duplessis and Mr. Leon Klarman from the Directorate of Management Information Systems at Natick R&D Center.

In addition, Captain Gerard Smits and Ms. Helene Bloom of the Behavioral Sciences Division, Science and Advanced Technology Laboratory, Natick R&D Center assisted in data collection and analysis of the pretest and in-test consumer and worker attitude data, they also edited the USERS MANUAL to ensure ease of use from the human factors point of view.

The authors would like to acknowledge the effort of Mr. Philip Brandler, Director, Systems Analysis and Concept Development, who provided valuable guidance in developing the concepts for automation of Air Force food services.

The authors would also like to acknowledge the efforts of the Air Force AFSOS project officers, CPT Walter Kelly and CPT Jim Cox, for their assistance in coordinating our activities at the test site, Seymour Johnson AFB, NC and for acquiring and furnishing information on the detailed Air Force food service procedures and functions to be automated. Finally, the authors would like to acknowledge the efforts of the personnel at Seymour Johnson AFB whose cooperation was critical to the success of the AFSOS test. In particular, we acknowledge the efforts of SSGT Ken Broder whose cooperation and willingness to utilize AFSOS contributed greatly to its success.

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INTRODUCTION

Comprehensive audits of military food service operations by the Defense Audit Service as well as the General Accounting Office have indicated that tens of millions of dollars and possibly as much as 100 million dollars are lost each year through a lack of appropriate management and control mechanisms in the operation of military dining halls. In response to this information, the Department of Defense tasked the individual services to develop appropriate automated management and control systems for food service operations. This report describes the prototype Automated Food Service Operations System (AFSOS) developed for the Air Force and tested at Seymour Johnson Air Force Base, North Carolina.

This system not only automates the many time-consuming calculations and report preparation procedures that burden the typical military food service staff, but, more importantly, it tightens the controls on inventory utilization and accountability and on the validation of the identities of those entitled to subsist at Government expense while facilitating the management control necessary for a well-run operation. Management functions such as forecasting meal headcounts were incorporated into the system to enhance management's ability to operate food services at the base level.

CURRENT MANUAL AIR FORCE FOOD SERVICE SYSTEM

Existing Methods and Procedures

Before describing the system by which management exerts its control of Air Force food service operations, there are some salient aspects of those operations that must be understood. Three features differentiate Air Force food service operations from those in one or more other branches of the Department of Defense or from other institutional food service operations such as in colleges or cafeterias: conversion to a la carte operations, customers meal payment status, and the diversity in types of operations.

Currently, the Air Force is in the process of converting from past military practice of meal pricing to a new a la carte concept. Those who have eaten in military dining facilities prior to 1970 might remember that they did not have an option to pay for each food item. Rather, a meal cost the same whether it consisted of only salad or whether it contained the full range of menu items available. Current Air Force a la carte operations bear a great similarity to practices in commercial cafeterias, where the customer selects and pays for each item.

In common with other elements of the DoD, Air Force customers can be divided into two categories: those who receive meals without charge as part of their wages and those who must pay cash for meals consumed in a military dining facility. The former group is referred to as "Subsistence in Kind" or SIK customers. When they choose to eat in the dining hall, these customers must show a meal card which, with their military ID, is taken to be evidence that they are in fact entitled to food and are not required to pay cash. The

customers who must pay cash are generally referred to as BAS customers. The acronym stands for "Basic Allowance for Subsistence" and simply reflects the fact that, for reasons they must demonstrate, it is not possible for them to eat in dining facilities on a regular basis. Typically, these are higher ranking (E5 and above) enlisted personnel who are married and live off base. Thus, instead of consuming meals at the governments expense in the dining hall, they are provided with a monetary allowance for the purchase of meals. Historically, the Air Force has been more liberal in allowing individuals to receive a BAS than have other services--a factor that increases the managerial workload in assuring that only the SIK customers consume meals provided at the government's expense.

Finally, the appropriated fund food service operation on an Air Force base involves the operation of one or more regular dining facilities with two main lines serving cafeteria fashion and with several small satellite dining facilities or food preparation areas designed for the specific needs of a select customer group such as the flight kitchen, fire station, or an alert personnel feeding facility. Typically there exists a centrally located food service staff office on the base wherein the Food Service Officer and Superintendent provide management and supervision of the food service staff, and the accountant performs the overall administrative function of reviewing and checking dining facility forms, many of which, depending on the size of the facility, are completed by storeroom personnel and shift leaders for review by the facility managers.

A complete description of Air Force food service operations can be found in AFR 146-7 "Food Service Management".[1] The point to be stressed here is simply that with the diversity in types of operations, customer's meal payment status, and the conversion to a la carte operations, management has responsibility for, and thus is expected to control, a large number and wide variety of transactions involved in what might seem to be a simple task of providing meals to today's airmen. As will be shown, the requisite reporting and control system is not so simple, especially when it must be implemented by manual means.

The Management Information System

Overview. To perform their functions of monitoring and controlling costs and operations, managers in Air Force enlisted dining facilities are, depending upon the viewpoint taken, either assisted or burdened by an information system that requires the preparation and review of more than 20 separate documents. Some are quarterly reports. Others must be completed on a daily basis. Many are prepared by office personnel or supervisors rather than by the manager--but all must be reviewed carefully by the dining facility manager.

The compilation, review and analysis of these records can consume a significant amount of the manager's time as well as his staff's. Some of the reports are very long; some must be completed after every meal; many require detailed calculations which then must be posted to other forms; and therefore, they are prone to many simple errors, which can take considerable time to isolate and resolve.

The time involved in preparing, reviewing, correcting and/or validating these records is time spent behind a desk rather than in the food preparation area, in the storage areas, or in seating areas. Such important tasks as monitoring meal preparation activities, interacting with customers and hearing their suggestions, or taking time to formulate new ideas or improve operations thus may not be given the time and attention they deserve. The Defense Audit Service, cited earlier, has enumerated other problems with the current manual system including potential for fraud and waste in food service operations.

A macro system flowchart indicating the forms used to process the flow of information from planning, preparation, and serving of meals in the dining facility to the preparation of the final monthly base summary is presented in Fig. 1.

Meal Attendance Records. Dining halls converted to a la carte operations use point of sale (POS) electronic cash registers (ECR), which generate meal, cash, and attendance summaries. These summaries include headcount statistics for SIK Personnel and cash sales for BAS and all other personnel including officers, civilians, dependents, etc. The output from the ECR's is currently used by the Air Force as a verifiable audit trail.

The output of the ECR's has replaced three forms that were previously prepared manually (and still are in those facilities that have not yet converted to the a la carte concept). These forms are the "Register of Cash Collection Sheets" (AF 1254), "Dining Hall Signature Record" (AF 1339), and the "Cash Collection Record" (AF 79). Considered as a group, these three forms are intended to provide a legible audit trail documenting the number of meals served and the SIK customer who was served.

The "Register of Cash Collection Sheets" is a prenumbered form obtained from the base publications office. The dining facility manager uses this form to record and control the distribution of the other two forms (AF 1339 and AF 79). Personnel in the Food Service Staff Office and Dining Facility Manager's Office complete the register when issuing the signature and cash collection sheets to cashiers just prior to the start of the meal. New signature and cash collection sheets are issued for each meal and are used throughout the meal period. Two separate "Register of Cash Collection Sheets" are maintained: one for the "Dining Hall Signature Record" and one for the "Cash Collection Record". The serial numbers from these forms are posted in numerical order on the "Register of Cash Collection Sheets".

The "Dining Hall Signature Record" is a particularly important as well as a troublesome document. It is a signature sheet which is intended to serve as a verifiable audit trail identifying personnel who have a meal card and who were fed in the dining halls. Separate forms are used for each branch of the DoD to specifically identify the number of individuals from each branch who were fed and whose meal costs must thus be accounted for under commmon or cross service reimbursement procedures. One of the many deficiencies noted in the Defense Audit Service report was the poor legibility of these signatures, and therefore, the inability to use them as a verifiable audit trail. In

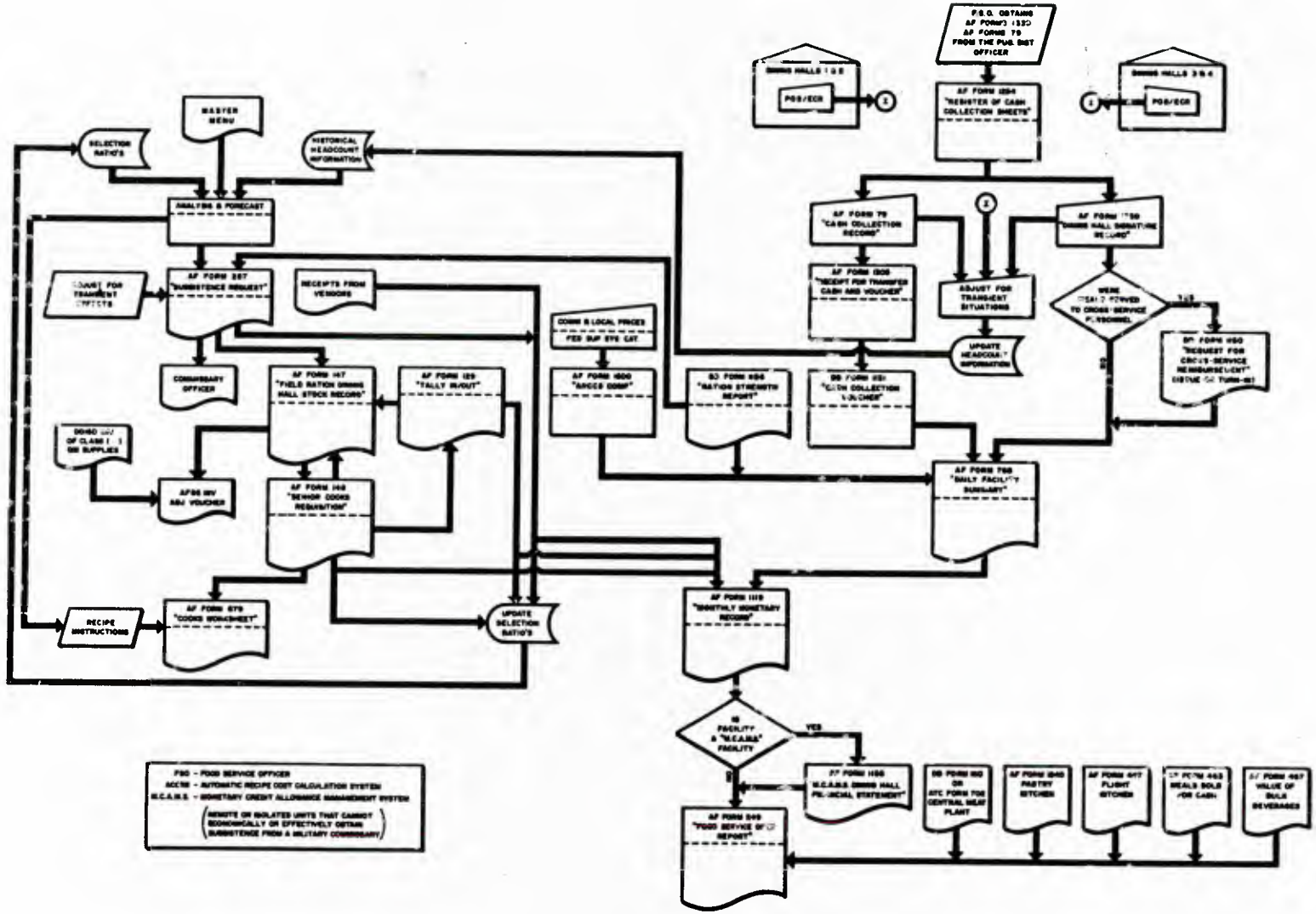

Figure 1. **Macro System Flow Chart**

addition, the requirement to sign his or her name is often criticized by customers as, in their view, an unnecessary source of irritation and delay.

In a la carte operations, meal card numbers are entered directly into the ECR by the cashier. Although this provides an improvement over signed headcount sheets, the ECR tapes are still not a completely accurate audit trail due to cashier input errors.

The "Cash Collection Record" is completed by BAS customers and is used to account for money received for each meal, including any surcharges, from each person. Although not criticized as often, it too is a source of customer irritation and delay.

The "Cash Collection Voucher" summarizes all cash collected during a given day. Input for the completion of this voucher is provided by the cash register tapes from each meal. Upon completion of this form by the food service staff accountant, it is sent to the disbursing office.

The accountant then prepares an "A La Carte System Daily Dining Facility Summary" (AF 1650a) using input from the ECR summaries. This is a daily accounting summary prepared for each regular dining facility. It details the number of meals (i.e., breakfast, lunch, dinner, midnight) eaten by each of the different categories of Air Force personnel eligible to eat in the appropriated fund dining halls. In addition, the volume of cash sales and surcharges is detailed.

Ordering and Receiving. The "Subsistence Request" (AF 287) is used as the basis to obtain subsistence from the commissary. Typically, a separate sheet is prepared by storeroom personnel for perishable and for nonperishable items. These requests are sent from the dining facility to the commissary three times weekly, usually on a Monday, Wednesday, and Friday. The orders are received by the dining halls one day after the commissary receives the request. Separate forms are prepared for bread and pastry bakeries and for vendor delivered items.

The quantities ordered and the prices of all items on a subsistence request are posted to a card inventory file by storeroom personnel. These cards are extended to detail the dollar value of food items received by the dining hall. The dollar value of food received is then posted to the "Monthly Monetary Record" (AF 1119) as well as to the "Field Ration Dining Hall Stock Record" (AF 147).

Dining facility storeroom personnel use the "Field Ration Dining Hall Stock Record" as a book inventory to control all subsistence supplies from the commissary, vendors, and other sources. All items, regardless of the planned consumption date, are posted on this stock record.

One of the differences between food service operations in the services is whether food and ingredients are tracked from the loading dock to the storeroom and then the kitchen or whether they are simply tracked from the dock to the kitchen. Unlike Army operations, the Air Force tracks food items

from the loading docks to the storerooms and then to the kitchen; that is, each AF EDF has a dining hall storeroom with an accountable supply clerk who receives his/her stocks from the commissary and who issues it via accountable forms to the senior cook. The primary control documents in this chain are the subsistence request and the senior cook's requisition form.

The "Senior Cook's Requisition" (AF 148) is used by the senior cook or by storeroom personnel to issue ingredients from the dining hall storeroom to the kitchen so that food preparation may commence. After the meal any unused food items are returned to the storeroom and noted on the "Senior Cook's Requisition" which is then adjusted for returns and extended to detail the food cost for that meal. Information from this form is then posted to both the "Monthly Monetary Record" and the "Field Ration Dining Hall Stock Record".

The "Tally In/Out" (AF 129) is completed by each dining hall for the turn in of subsistence to the commissary, for transfers between dining halls, and for issues to dining halls from central preparation facilities. The value of the subsistence transferred is posted on AF Form 1119, the "Monthly Monetary Record".

Food Preparation Records. One of the more important documents intended to control food service operations is the "Production Log" (AF 662). It is used by the shift leader to plan, prepare, cook, and serve each meal in the dining hall. Intended for use only as a worksheet, this form does not establish accountability within the food service account. Worksheets may be destroyed 60 days after the end of each month.

Recipe cards from the Armed Forces Recipe Service are or should be used by the cooks to prepare each menu item on the "Production Log". The recipes are designed to yield 100 portions. The weights and measures for each ingredient on the card are supposed to be extended manually by the cook to determine the quantity of each ingredient in the recipe necessary to prepare the forecasted number of portions required for the meal. However, these calculations are often not made, and the cooks use their best estimate for the quantity of each ingredient required.

Inventory Control. The "Inventory of Class I Quartermaster Supplies" (DD 160) is used in completing a physical inventory taken to determine the actual value of subsistence on hand, the accuracy of records maintained by the storeroom personnel on the "Field Ration Dining Hall Stock Record" and the effectiveness of internal controls.

A record of the physical count is made in the inventory form by storeroom personnel usually on or near the close of business on the last day of the month. The results of the physical inventory are reconciled with the "Field Ration Dining Hall Stock Record," which is the book inventory. If there are significant differences between the book and physical inventories, the dining facility supervisor is required to complete an "Inventory Adjustment Voucher" (AF 85). This action is required if and when the differences between book and physical inventory dollar value adjustments exceed 1% of the book value. When completed, the inventory voucher identifies all overages as well as all shortages.

Financial Status. AF Form 1119 provides a daily status of earned income versus subsistence expenditures for each dining facility. This form is updated daily by the food service accountant and completed monthly. To perform this activity, he or she uses input from AF Forms 1650a, 287, 129, and 662.

The most significant summary of dining facility operations is the "Food Service Operations Report" (AF 249), which provides overall accounting of the entire base appropriated fund, food service operation. This is a monthly report prepared by the food service accountant, reviewed and approved by the superintendent and Food Service Officer, and sent to major command headquarters at the end of each month. Summarized in this report are the quantities and costs of all types of appropriated fund meals served on the base, the numbers and types of personnel they were served to, the appropriated fund manpower assigned to each facility, and the appropriated fund food service personnel assigned and authorized on the base.

AFSOS SYSTEM DESCRIPTION

Software

The AFSOS software consists of sixty software programs written in BASIC that are all callable through a hierarchical systems directory. In computer language this directory is referred to as the "systems menu". However, to food service personnel the word "menu" has a very different and distinct meaning, that is, food recipes to be prepared and served on given days. Therefore, the series of programs available to the AFSOS user is referred to, in this report as well as in the system documentation, as the "Systems Directory."

The software was designed as a hierarchy of individual programs to lead the user to his or her desired application. This design feature assures that the system is "user friendly" which is to say that it can be used successfully by individuals who are not computer technicians or even experienced operators. The software has been written so that food service personnel with no prior experience with computers can, and in fact did, operate the system.

Complete documentation of the software is beyond the scope of this report. A brief description of the programs and functions, however, is necessary. Fig. 2 provides a schematic overview of the major system components and their interrelationships.

The Security System. The Security System controls user sign on, access to modules, and access to programs within a module. Only authorized personnel are recognized by the system and then allowed access to other programs in the system. Only the Food Service Officer has supreme access which means that he or she may access and run all programs in the systems directory. The person with supreme access is also the only individual allowed to add or delete users to and from the system. Once a person has been entered as a valid user, that person may sign on by correctly entering his or her Social Security Number and password and then access those modules for which the individual is

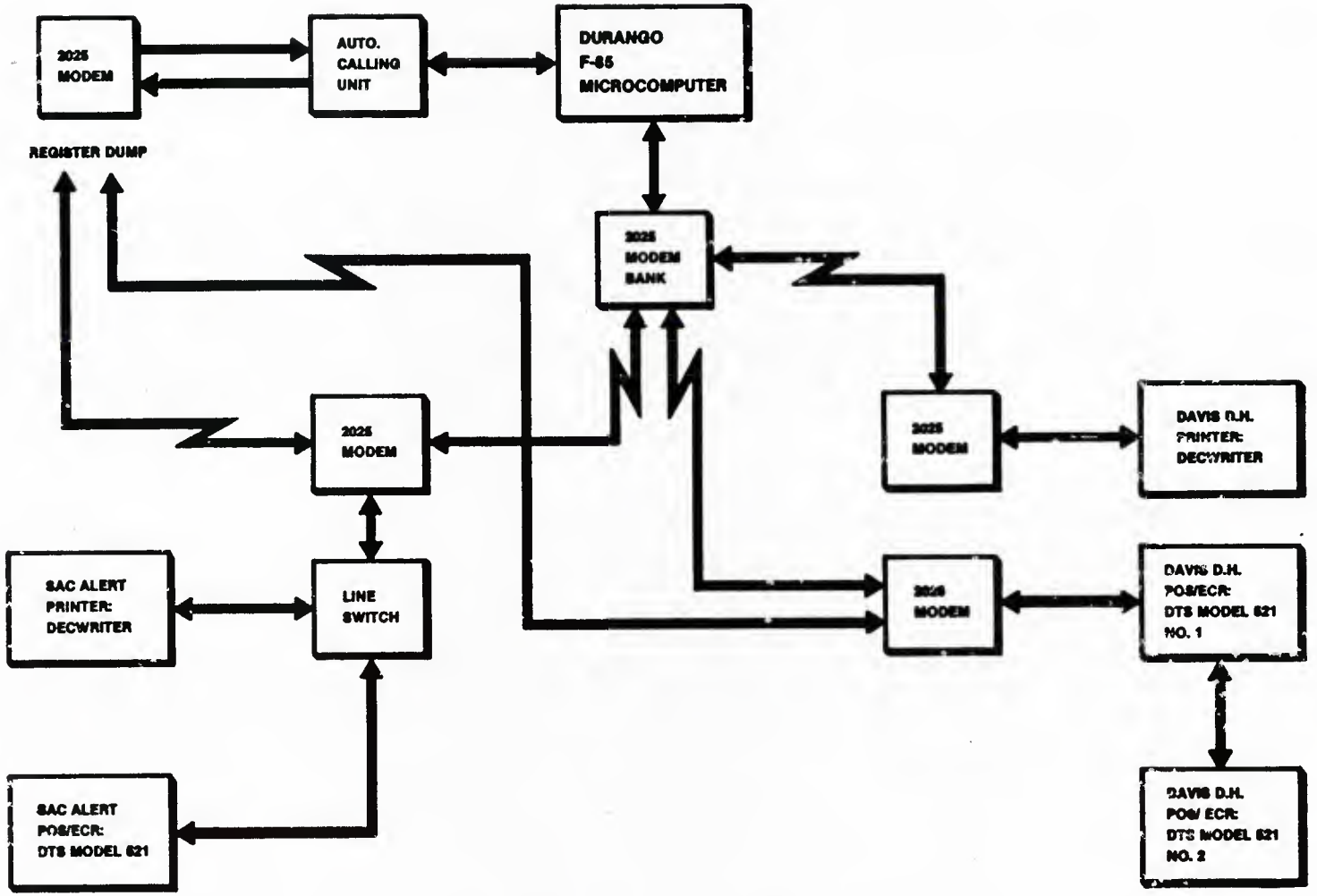

Figure 2. AFSOS Hardware and Telecommunications Network

authorized. However, the food service officer must, for all new users, specify which modules the new user will have access to. In addition, there are a series of programs within each module to which the person with supreme access may deny to others access or use.

The File Maintenance Module. The file maintenance module allows food service personnel to create and update individual files within the automated system. The operator selects the data file and action to be performed. He or she may, for example, want to make a revision to a particular recipe. The operator would key in "recipe update"--in this case calling in the recipe update file. A series of prompts are then presented by which the operator enters new information such as a new ingredient or a new quantity. After all the data have been entered for a given transaction, the operator is asked if the transaction is correct as entered while the information is displayed on the video display unit (VDU). If the operator responds affirmatively, the transaction is processed, and the previous version of that record is replaced with the new version. If the operator response is that the information visually displayed is not correct, he or she is queried as to which field is in error. The reply allows that field to be corrected without re-entering the entire transaction. The operator is then queried again as to whether the transaction is correct, and processing proceeds as described above.

The Forecasting Module. The forecasting module consists of several subroutines that generate forecasts of headcount and menu item selection ratios. The headcount forecasting subroutine uses algorithms developed from multiple regression analysis of Air Force headcount data. The resulting algorithms consist of a series of mathematical equations that generate the prediction for each dining facility based on the "present for duty strength", the day of the week, the number of days since the last payday, the month, and the holiday status. The headcount forecast does not include transient effects such as those resulting from the arrival of reserve units or any other temporary activities that would significantly increase or decrease attendance. The food service managers must change the headcount forecast when such transient effects or atypical conditions are anticipated. The headcount forecasting module generates forecasts up to one year in advance of their usage date. This capability is necessary to produce the required 120-day forecasts of food requirements for the commissaries in OCONUS operations.

The menu item selections subroutine generates forecasts of the menu item selection ratios for the main entrees, short order, and special sandwiches served at meals during the period of the forecast. The selection ratios are derived from a weighted average of the three most recent servings of a unique group of items. One unique entree group, for example, is pepper steak, short ribs of beef, and fried chicken offered on the main serving line with cheeseburgers on the short order line and grilled cheese sandwiches on the special sandwich line. The selection ratios of this grouping will be different from another group of entrees served at this or another meal. The actual quantity of each item selected is recorded after each meal by manually entering items sales data obtained from the ECR's located in the dining facilities. The selection ratio forecast is used only for the main entrees. Standard issue factors are used for all other items.

The output of the forecasting module (consisting of the above two as well as other subroutines) is used in the menu production module to determine the quantity of food items required for each meal and for forecasts of food demand from the commissary.

The Menu Production Module. The menu production module generates the quantities of all recipes and ingredients required in the preparation of meals to be served in the dining hall. This includes determining the number of specific ingredients required to be drawn from the storeroom as well as computing the amount of each ingredient needed for the preparation of each menu item. This module is "menu driven" in that a cyclic menu specifying each meal and the date it is to be served must be established in advance of using this module. After the cyclical menu is established, the forecasting module is called to obtain the headcount and selection ratio projections for the specific menu item groupings. One output of this module is then the cook's worksheet specifying the menu items and quantities of required ingredients. The ingredient quantities are expressed in values familiar to the cooks: pounds, ounces, tablespoons, teaspoons, cups, etc. All of the arithmetic extensions of the Armed Forces Recipe Service recipes, from the 100 portions on the cards to the greater or lesser portions required to feed the projected customer load, is done by the computer. The problem that cooks have had in performing the calculations correctly is thus eliminated by this feature of the AFSOS system. The menu production module also prepares forecasts of the ingredient requirements necessary for the given menu up to 31 days from the current date.

The Inventory/Order Module. This module is designed to record current levels of all inventory items as well as to produce all food orders required to replenish dining hall inventories. There are four subroutines: the ingredient order quantity, the ordering procedure, the stock replenishment, and the inventory reconciliation programs.

The ingredient order quantity program determines the quantity of each ingredient that should be ordered based upon the menu requirements for a given cycle and the current on-hand inventory levels. A projected ingredient requirement file, generated by the menu production module, is created and details the amount of food ingredient (by ingredient number) necessary to serve the meal. The value in this projected ingredient file is then subtracted from the quantity on-hand in the ingredient file. If the result is equal to or less than the reorder point, an order is created and written to the orders file. If the result is greater than the reorder point, no order is created. An order requirements list is generated in ingredient number sequence for the current menu cycle being processed and a file of order actions is stored for updating during the order file update process.

The ordering procedure is divided into two phases. Phase one generates an order for the Commissary based on the order requirements list detailing the quantity of each ingredient required in the case size supplied by the Commissary. The Commissary returns this form with the actual quantity issued to the dining hall. In phase two the user inputs the quantities and prices of

all ingredients received and the inventory file is automatically updated. The total dollar value of receipts is also posted for the Accounting Module to detail the dollar value of receipts from the Commissary.

The system will maintain a maximum of three different prices with a quantity on hand for each price of an ingredient. If an ingredient is received with a new price and there are already three different prices, an error message is printed. Each time an ingredient is updated, the quantity on hand for a price is checked for zero balance; if so, that price and quantity combination is deleted from the file and the other two quantity/price combinations are shifted one position so that the most recent combination is located in the first possible location. The total quantity on hand for an ingredient is calculated by adding the quantities at each of the three prices. This total is then compared to the minimum reorder point for each item; and if the total quantity on hand is less than the minimum reorder point, sufficient quantities of ingredients will be ordered during the next cycle to (1) raise all inventory levels to the minimum reorder point and to (2) handle the projected demand for each ingredient as detailed in the projected ingredient requirement file. Any and all transfers of inventory from one dining hall to others are manually input, using the file maintenance module, before the processing to create new orders takes place.

A physical inventory must be taken at the close of each month. The first step in this process involves printing the inventory count sheets that list all of the ingredients that may be in the dining hall inventory. After these sheets have been distributed, the actual inventory is counted by food service staff personnel. The physical inventory values are then entered and an inventory variance report is produced showing the discrepancies between the actual and computer inventories. All manual corrections based on the variance report are entered in the file maintenance module so that the computer and actual inventory levels match and an audit trail of all such corrections is created for the Food Service Officer.

The Access Control/Automated Headcount Module. This module provides real time physical access control in all the regular appropriated fund dining facilities that utilize electronic cash registers. All cash registers are electronically linked to the microprocessor. After proceeding through the serving line, the SIK customer gives his or her magnetic-stripe meal card shown in Fig. 3 to the cashier, who inserts it into a card reader attached to the cash register. The card reader then sends the card number, which is the individual's social security number, to the microprocessor where the card is validated using a file containing all valid card numbers. The file also includes a starting and an expiration date as well as historical data that indicates the meals and dollar value of food consumed using this meal card.

The validation of the meal card includes several checks. One check, for example, determines whether the meal card number is valid and the expiration date has not been exceeded. If these conditions are met, the meal will be allowed to be rung up as a credit sale. If the number is invalid, the register will be locked so that the sale cannot be rung up for credit. The

Figure 3. APSOS Magnetic Stripe Meal Card

transaction in this case can only be entered as a cash sale - unless the cashier manually overrides the infraction and enters a valid reason (for example, "transient authorized SIK"), which is subsequently recorded on a report of all manual overrides.

Another check is a repeated meal-card-usage check. In this case the card is compared with the historical data on the use of this card: specifically, the number of each type of meal (breakfast, lunch, and dinner) consumed and in which facility the meal was taken. The data are retained over the prior 24-hour period. If the card has appeared, for example, at another dining facility during the same meal period, an invalid meal card message is sent to the cash register. The message will automatically lock out the register. The transaction in this case can only be entered as a cash sale and the dining facility manager will not be entitled to claim a monetary credit for this meal. For a complete list of meal card exceptions and infractions, please refer to Table 2 in the next chapter.

The Accounting Module. This module generates the information necessary for the computer creation of dining hall and base accounting forms. It is designed to process data for appropriated fund dining halls found on a typical Air Force base including alert and flight line facilities as well as any other specialty food service outlet operated by the appropriated fund system.

The initial input for the accounting module is the dining hall cash and attendance summary data which is input either manually or telephonically via a Bell Modem from the ECR's in the dining halls. This data is retained in an "earned credits" file. The final output of the accounting module is AF Form 249," Food Service Operations Report," which was described in an earlier section of this report. It is a monthly summary of the entire base food service operations for a given month and contains the quantities and cost of each type of meal served, the numbers and types of personnel served, and the numbers of and types of personnel authorized and assigned on the base. The automation of the Air Force food service system ends at this point, and only the printout of the "Food Service Operations Report" will be sent to the requisite major commands.

The potential does exist for communication between the microcomputer and other computer systems using an asynchronous/synchronous communications interface option. This requires that communications driver and control logic software and RS-232-C interface hardware combine to provide the link between the microcomputer and external data communications equipment.

The Report Preparation Module. This module consists of a program that will produce printed reports from data stored on floppy disks in print image format. By saving all reports on disk, rather than merely printing the report as it is generated, the food service personnel may schedule report printing at nonpeak periods and better utilize the microprocessor. Further, the reports that are spooled may be printed at any future time. The printout program accesses the spooled file which is either stored on the fixed disk or on a floppy diskette for rapid uninterrupted printing.

Hardware

The hardware used to develop the AFSOS concept and technology demonstrator is as follows:

° Micro Computer System including:

1 Video Display Unit
1 Printer
1 Keyboard
2 Floppy Diskette Drives (1 megabyte)
1 Fixed Disk (24 megabytes)

The specific microprocessor used was the Durango F-85 with 192K RAM Memory.

° Electronic Data Terminals

° Electronic Cash Registers including:

Magnetic Stripe Card Readers
Pole Displays
Expanded Keyboards

Modems
Expanded Memory
Telecommunications Boards

° Automatic Calling Unit

° Modems for telecommunications

The electronic data terminals were Decwriter III's manufactured by Digital Equipment Corporation while the electronic cash registers were Data Terminal Systems Series 521 units.

A schematic of the system hardware is presented in Figure 2. Pictures of the equipment are shown in Figs. 4, 5, 6, and 7. The microcomputer system including associated automatic calling units and modems for telecommunications is located in the base food service staff office. An electronic data terminal is located in the storeroom of each of the main dining facilities. In addition, an electronic cash register with a magnetic stripe card reader is located on each of the serving lines in the dining facilities. Each data terminal and cash register has a modem to provide direct telecommunications via telephone lines with the microcomputer in the food service office.

Failure Protection. One of the more frequent questions asked by potential users of automated systems is, "What happens if we lose power or the system goes down; will I lose my data?" There are several contingency plans that have been incorporated into the AFSOS system design to minimize problems associated with computer system failure. Loss of electrical power, for example, is compensated for by the inclusion of battery packs on the cash registers. This will permit the collection of meal headcounts and item selections even if a power failure occurs in the dining facility. Electrical power fluctuations are smoothed by voltage regulators to provide continuous computer operations. For the more serious problem of computer system failure, a manual backup procedure was developed and used in lieu of an uninterruptible power supply such as a generator. While the system is inoperable, the data will be retained on their original data forms until the system is brought up again. The software is designed to then accept the accumulated data then entered manually. The operator merely keys in the dates and meals for the data to be entered. This feature may also be used to input data at periods when the computer normally might not be operating such as during a midnight meal.

A provision is also made so that the data may be corrected if it is determined that some information currently residing in the system data base is faulty. Of course, there is an element of security required due to the need to maintain a verifiable audit trail. The computer system's operator or staff accountant must retain relevant information to validate to an auditor that the corrections were necessary and were made. Automatic exception reports are generated when such corrections are made.

Another safeguard is that a copy of the data base is stored in a secured location such as a safe. The data files maintained in the automated system are copied on a regular basis and stored in the secured area. These files are retained until such time as it is determined they are no longer necessary.

Figure 4. AFSOS Microcomputer: Durango F-85

Figure 5. AFSOS Electronic Data Terminal: Decwriter III

Figure 6. AFSOS Electronic Cash Register: Data Terminal System Model 521

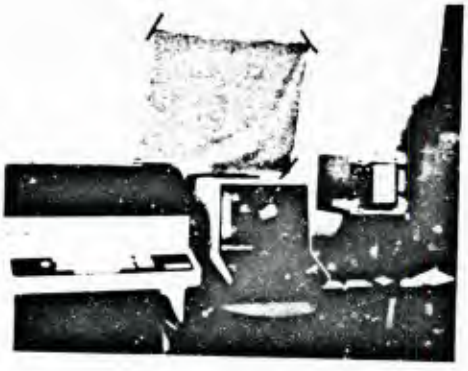

Figure 7. AFSOS Card Issuing Equipment

TEST RESULTS

Background

Prior to shipping the AFSOS technology demonstrator to Seymour Johnson Air Force Base for a six-month evaluation period, the prototype system software and data base development was completed at Natick R&D Center. Because it was designed as an independent stand-alone system, AFSOS was ready for implementation upon arrival at the test site.

The current manual system was operated by the Air Force Food Management Assistance Team concurrent with operation of the automated system for the first two months of the test effort in order to verify the results of the automated system. However, the automated system had been designed to work with the existing forms, so there would not be a difficult transition from the manual to the automated system. In fact, the transition was easily accomplished, and the manual system was phased out on schedule.

There are two major data collection periods. The first occurred before AFSOS was installed and constituted an evaluation of the current manual system. The second data collection effort was undertaken during the fifth month of the test period. Thus, this information provides a basis for an evaluation of the impact of the automated system.

The data collection focused on three major areas: access control, food service personnel workload, and operational impacts. Methods used to collect this information included detailed work sampling, questionnaires, interviews, and cost data.

Access Control

Meal Card Issuing. A new procedure was established for issuing meal cards to military personnel. Previously, personnel who were on Subsistence-in-Kind (SIK) were issued a paper meal card by their respective squadrons. The AFSOS system required these people to acquire documentation from their squadron indicating their right to SIK status and to then travel to the PASS and ID office on the base to acquire a new embossed plastic, magnetic-stripe, meal card with attached picture as shown earlier.

A total of 1393 cards were issued during the six-month test effort, while 379 (27%) cards were voided as personnel either transferred to Basic Allowance for Subsistence (BAS), were separated from the service, or transferred to another base. The total number of personnel on meal cards in a given month during the reporting period is shown in Table 1 and was derived by adding the number of new cards issued to the previous month's number of personnel on meal cards and then subtracting the number of voids. During the test there were an average of 1001 people subsisting on SIK. Of this group only 16 (1.6%) people lost their cards and only two reported a damaged card that had to the replaced. In some cases, the magnetic stripe had to be re-encoded but the card did not have to be replaced.

TABLE 1. AFSOS Test Meal Cards Issued

	AUG	SEP	OCT	NOV	DEC	JAN	TOTAL	%
New Cards Issued	747	395	82	79	61	29	1393	100
Voids:	38	89	100	82	70	0	379	27
Total Number of Meal Cards		1015	997	994	985	1014	1014	73
Cards Re-issued								
Lost	0	6	0	6	4	0	16	1.6
Damaged	0	0	0	1	1	0	2	0.2
Cards Unsuitable for Issue	168	128	11	14	31	5	357	20

Of the total number of cards used during the six-month test, 357 cards or 17% were deemed unsuitable for issue due to mispunching during the embossing process, machine malfunction, errors on paperwork, or some other type of error. This high rate of card error occurred at the beginning of the test, as the equipment was new and considerable training was required before personnel became proficient with each piece of equipment used to issue meal cards. This card error rate went down to less than 10% during the test effort. However, an overall error rate of 17%, coupled with the fact that each card cost $0.67, means that a considerable startup cost could be incurred at a large base.

Existing Signature System. The Defense Audit Service (DAS) review of military food services cited deficiencies in meal card and headcount procedures, and their recommendation for automation was one of the driving forces of this project. Therefore, the results of the DAS audit the existing headcount control procedures is used as a baseline with which to judge the results of the AFSOS access control/automated headcount (AC/AH) module.

The Defense Audit Service (DAS) review of military headcount procedures indicated that 23 percent of the signature sheet entries were questionable. This report cited a sample of 1448 from a total of 40,348 signature sheet entries at seven dining facilities, which disclosed that 23 percent were questionable. The report cited that 7 percent were for entries with illegal signatures or numbers that could not be verified, and the remaining 16 percent were for cards recorded as issued to different individuals, not assigned for use, for individuals not on unit rosters, for personnel drawing monetary allowances, etc.

Real Time Access Control. In order to implement the real-time access control feature of the AFSOS system, it was necessary to more precisely and comprehensively define the types of meal card exceptions and infractions than is the case with the current manual signature headcount system. Fourteen types of exceptions and infractions were defined and used to determine the conditions under which the system would lock out the cash register from a credit sale and to develop messages allowing the cashier to understand the basis for rejecting the card. Table 2 summarizes these exceptions and infractions, some of which the cashier may override (MOA--manual override available) if the airman presents a valid reason, while others may not be overridden (NMO--no manual override) under any circumstances. The exceptions that are manually overridable represent the necessary reason entered by the cashier when manually overriding the computer-generated, credit-sale lockout.

The exceptions that are manually overridable are not infractions to the extent that these individuals should not be allowed to consume food at the government's expense. However, they do represent a situation whereby for various circumstances (described in Table 2) an individual did not have a valid SSN resident in the computer. For example the invalid SSN exception message does not indicate that the individual does not really have an invalid SSN and should not be allowed to eat. This exception results when the individual acquires a valid meal card (from the central issuing point), but the issuer was not able to enter the SSN of the new meal card holder into the computer. This computer updating procedure required the issuer to travel from the PASS and ID office to the Food Service Staff Office on a routine basis (typically three times per week) and enter all the SSN's of new meal card holders into the computer. If a person acquired a meal card and used the meal card prior to the issuer entering the SSN into the computer, then the ECR would display an overridable infraction entitled "INVALID SSN" which merely signified that this SSN is not in the SSN validation file in the computer. However, since the individual has a new automated system, plastic meal card, the exception was overridden and, most importantly, a verifiable audit trail was maintained for all these occurrences.

A verifiable audit trail was maintained for all the manually overridden exceptions including new meal card, unreadable card, individual on TDY, forgotten card, and card claimed as lost. The verifiable audit trail consisted of the individual's SSN, date, time, dining hall number, meal number, and reason for the exception. Therefore, the AFSOS access control/automated headcount module virtually eliminated all the questionable signature sheet entries as cited by the DAS review.

TABLE 2. Exception and Infraction Messages and Causes in the AFSOS Access Control Module

MOA--TDY	When user does not have card and gives TDY as reason.
MOA--New on	When user does not have card and gives "new on base" as reason.
MOA--SSN Not on File	When user's SSN is not on file, and card has been read.
MOA--Major Meals Infraction	When user has received a meal under SIK at more meal periods than authorized.
MOA--Unreadable Card	When the user has a card, and the card cannot be read. However, upon manual entry of the SSN, the number is in the Valid SIK File.
MOA--Forgotten Card	When the user claims to have forgotten a card. User must show other identification; and upon manual entry of the SSN, the number is in the Valid SIK File.
MOA--Stolen Card	When the user does have a card read, but it was reported stolen. User must show other identification; and upon manual entry of the SSN, the number is in the Valid SIK File.
MOA--Lost Card	When the user does have a card read, but it was reported lost. User must show other identification; and upon manual entry of the SSN, the number is in the Valid SIK File.
MOA--Second Helping	When the user already has been recorded has in the Valid SIK File as having had a meal during this meal period.
NMO--Day Limit Exceeded	When user is TDY or new on base and has not gotten ID card in allowable time.
NMO--Wrong Card Issue Number	When user has had card read and card issue number is less than the one that corresponds to the card issue number in the valid SIK File.

TABLE 2. Exception and Infraction Messages and Causes in the APSOS Access Control Module (cont'd)

NMO--Dining Hall Infraction	When the user has had a meal in one dining hall and tries to buy another during the same meal period in a different dining hall.
NMO--Too Many Seconds	When the user has had more than the maximum allowable number of seconds during meal period.
NMO--Invalid Reason	When the user has given an unauthorized reason for not having an ID Card, or the reason given for not having a card differs from the one already in the Valid SIK file.

MOA = Manual Override Allowable
NMO = No Manual Override

A summary (by percentage) of the exceptions occurring due to a manual override at the cash register is presented in Table 3. As previously described, personnel who register as "invalid SSN" actually have a meal card, but the file in the computer has not been updated to reflect that fact. The other exceptions (unreadable card, forgotten card, and lost card) all indicate that the individual has a valid SSN in the file, which was verified as the person was waiting at the cash register. The verification process requires the cashier to input the person's SSN with the appropriate reason code, and the computer checks to make certain the SSN is valid. Another exception is for personnel on TDY. In this case these people must possess a valid copy of their TDY orders, which clearly states that they are entitled to Subsist in Kind (at the government's expense). Therefore, these exceptions all require the individual claiming authorization to Subsist-in-Kind to have some sort of valid proof, whether it be a plastic meal card, orders, or valid SSN in the computer file.

TABLE 3. Summary of Access Control Exceptions (headcount percentage)

	B	L	D	M	Overall
Invalid SSN	6.1	6.2	6.9	7.4	6.6%
New on Base (people have not acquired a meal card)	2.2	1.4	1.8	1.7	1.8%
Unreadable Card (card was x-rayed)	1.2	1.3	1.5	2.6	1.6%
TDY	0.4	1.4	1.5	1.6	1.2%
Forgotten Card	2.2	1.7	1.7	3.3	2.2%
Lost Card	0.4	0.6	0.6	1.0	0.6%
				TOTAL	14.0%

Note: B = Breakfast, L = Lunch, D = Dinner, M = Midnight meal

There is also an exception for personnel new on the base who have not had an opportunity to acquire a meal card. These people are informed that they must acquire a meal card within a specified period of time (for example 5 days), or they will have to pay for meals consumed in the dining facility. An audit of these exceptions was made by reviewing the reports of personnel who claimed to be new on the base and checking to determine if in fact they acquired a meal.

The audit revealed that 40% of these people never in fact acquired a meal card. Therefore, since 1.8% of the meals were served to personnel claiming status as new on the base and entitled to Subsist in Kind, then less than one percent (or 40% of 1.8% = 0.72%) of the meals served are questionable as to the validity of the authorization to consume meals at the government's expense.

All other true infractions, identified in Table 2 as NMO (no manual override), were eliminated by the system; therefore, one may draw the

conclusion that questionable headcounts were reduced from a DAS determined pre-AFSOS level of 23% to the less than 1% identified in the previous paragraph.

Automated Forecasting

The history of the numbers of customers served form the basis for a crucial management function: forecasting customer loads, and thereby planning how much food to order, store, or prepare. Before focusing more explicitly on the test results in these areas, the accuracy of forecasts made under the manual and the automated systems are both an interesting and important comparison. The more accurate forecasting results, of course, should be used for decisions regarding inventory control and food production. Not surprising, the results favor the AFSOS forecasts over the "informed judgment" of food service managers.

Although not true throughout the Air Force, there was no real forecasting conducted by the food service staff prior to the AFSOS test. A review of the manual operation indicates that the same number of entrees were prepared day after day for a given meal. Whether this was the result of careful calculations or a simple expedience to save time is not known. However, food service managers did, during the AFSOS test, exercise their prerogative to override the computer generated predictions.

To compare the accuracy of the predictions from the regression model, the actual meal headcounts spanning a thirty-day period during the last half of the test were analyzed. The first analysis involves a comparison of the automated system regression model headcount forecasts versus the actual headcount during the meal period, which is shown in the column labelled "automated" in Table 4. The overall average for the four meal

TABLE 4. Average Percent Error for the Computer Generated and Manual Headcount Forecasts

	Forecast In Accuracy	
Meal	Automated	Manual
Breakfast	15%	23%
Lunch	13%	21%
Dinner	24%	23%
Midnight	11%	20%
Overall	16%	22%

periods was 16%. The forecasts for breakfast, lunch, and midnight meal periods were reasonably close considering that there were many special exercises conducted during this period that introduced considerable uncertainty and brought more people than normal into the dining facility. The dinner forecast was off by an average of 24% which probably resulted from the

fact that during these exercise periods there appeared to be a greater increase in the dinner meal headcount than at any other meal period. In 50% of the cases, or 45 of the 90 meals, managers revised the computer's headcount projections. The need to do so was generated because of the many exercises and alerts when heavy headcount was expected because personnel worked extended hours. In this case however, one would expect the manual adjustments to be more accurate than the automated headcount forecasts.

However, this expectation was not true as shown in the results summarized in the column labelled "manual" in Table 4. Overall, the average error for computer generated forecasts was 16% compared to 22% average error in the manually adjusted forecasts. Only for the dinner meal is the food service manager's forecast more accurate as measured by the average error, and the difference is but 1% less than the error associated with computer generated forecasts.

The fact that the managers elected to revise the headcount forecasts 50% of the time indicates a lack of confidence in the automated system forecasting module. The poorer performance of the managers' revised forecast indicates a lack of the ability of food service personnel to accurately forecast the magnitude of the changes during exercises and alerts.

Inventory Control

Another of the DAS and GAO reports' findings highlighted the problem of inventory control in military dining facilities. Management controls in this area were weak and resulted in substantial losses. Automation was thought, by DAS and GAO, to be the answer for tighter control of inventories, and results from the AFSOS test indicate that automation may indeed provide a powerful tool.

There was a reduction in the amount of the average inventory item dollar value. As noted in Table 5, the total number of ingredients being maintained in the dining facility declined from 456 prior to the test to 350 during the test effort. Because the facility went from a 42-day to a 14-day cyclic menu, some of the ingredients were no longer required. Most importantly, however, the average dollar value of the inventory went steadily downward during the test effort. The average dollar value of each ingredient was calculated by determining the total dollar value of the inventory and dividing that by the number of ingredients maintained in the inventory. Therefore, the use of a shorter cyclic menu that requires fewer ingredients would not affect this figure since both the total dollar value and number of ingredients would decline, thus not changing the average to any great extent. During the first four months of the test, the average dollar value of each ingredient declined from $26.91 to $24.63 which reflects an 8.5% decrease. A lower monetary value during the AFSOS test reflects improvement over the manual system.

TABLE 5. Average Dollar Value Per Inventory Ingredient

Date	Total Value (Dollars)	Number of Ingredients	Average Value Per Ingredient (Dollars)	Cumulative Difference (Percent)
31 May	$12,269.74	456	$26.91	--
31 Dec	$8,623.19	350	$24.63	8.5
28 Feb	$7,926.58	350	$22.65	15.8

Further, during the last two months of the test the average value of the inventory for each ingredient declined further--from $24.63 to $22.65, an additional 7.3% decrease. During the latter part of the test, the food service personnel began to become proficient in operating the AFSOS effectively. Therefore, the large reductions were noted near the end of the 6-month test. Overall, a 15.8% decrease was noted in the dollar value per ingredient of the inventory.

The AFSOS requires food service personnel to monitor very closely food waste resulting from inventory losses. The ingredients received from the commissary are all input using the inventory module, and an up-to-date book inventory is maintained in the computer files. An ingredient can only be removed from the book inventory if it is issued to the kitchen. Otherwise, the file maintenance module must be used to monitor and update the book inventory. In doing so, an audit trail is generated automatically. Each time an inventory reconciliation is performed, the computer maintains a historical record of all differences between the physical and the book inventories. This control encourages storeroom personnel to very closely monitor ingredient inventory levels. During the test there was, in fact, a marked increase in the number of reconciliations performed as compared with the number of similar actions observed before AFSOS was installed. One of the reasons more inventory reconciliations occurred under the automated system may be that the task is easier than when records are strictly manual. Or, there simply is more discipline required when records are automated. In either case, an important management objective is facilitated by automation.

Food Service Labor Impact

Although the AFSOS concept was not and is not designed nor intended to reduce labor requirements in Air Force dining facilities, the automated system should have a significant impact upon the distribution of activities performed by both managers and workers. The results documented in this section describe the difference in the distribution of times associated with activities performed under the manual and the automated food service information systems.

Food Service Accountant. The individual most directly affected by the AFSOS requirements is the food service accountant whose duty it is to enter, review, and correct the wealth of accounting data which, in turn, comprise the management reports. The Food Service Superintendent at Seymour Johnson AFB (SJAFB) delegated much of the responsibility for computer system operation, security file updating, and audit trail printout generation to the food service accountant. In addition, the food service accountant was required to perform the normal duties associated with an accountant's position on an Air Force base. This requires the incumbent to maintain, update, and generate all the Air Force accounting reports.

In order to quantify the time taken to complete his tasks, the accountant at Seymour Johnson AFB was asked to maintain a time log for a one-week period in both the pretest and in-test data collection periods. The log required him to write a three-digit code every 15 minutes. The first digit noted the location where he was working, and the second two digits noted the activity being performed. In both data collection periods a list of categorized activities was provided on the time log. Examples of the time logs are included in the Appendix.

There was only one individual performing the food service accountant's function at Seymour Johnson AFB, and this individual worked approximately the same number of hours prior to as well as during the test effort. During the pretest period the accountant worked 10.8 hours per day, and during the test effort he worked 10.95 hours per day.

The distribution of time within the accountant's 11-hour day did, however, change dramatically as shown by the comparisons in Table 6. The time spent on the manual accounting functions was reduced from 50.1 to 26.4% during the test effort. However, this reduction was offset by the new functions performed: operating the access control program; updating the file maintanance module data base; using the report module to produce a backup of historical reports on computer readable media; and monitoring the security system. The net effect, when adding the 52.1% of time spent performing automated accounting activities to the 26.4% still spent in performing operations in the AFSOS operation, is an increase to 88.5% of the accountant's time spent on productive accounting operations.

The increase in productive accounting time was attained by the elimination of such activities as travel performed under the manual system. The reason for the reduction in travel is not entirely clear, but it may reflect the fact that not all of the travel time spent under the manual system was essential. There is also a reduction in the time spent on supervisory and administrative duties and in productive nonaccounting tasks such as picking up office supplies and performing military duties. One must be cautious in attributing too much significance to such changes, however, as the standard error of measurement for these values is quite large. One conclusion to be drawn from the results presented in Table 6 is simply that

TABLE 6. Comparison of Time Spent by the Food Service Accountant under the Manual and the AFSOS Systems

Activity	Pre-Test (Percent)	In-Test (Percent)
Accounting	33.0	17.8
Menu production	8.1	5.4
Inventory reconciliation	9.0	3.2
Subtotal for common accounting tasks	50.1	26.4
Access Control		18.3
File maintainence		9.1
Report spooling		8.2
Security system operations		15.5
Forecasting		1.0
Subtotal for AFSOS unique tasks		52.1
Manual nonaccounting tasks		6.9
Productive nonaccounting tasks	26.6	5.0
Administration/supervision	15.1	7.8
On-the-Job training		1.8
Travel	8.2	
TOTAL	100.0%	100.0%

more time was spent on accounting related productive tasks under AFSOS than was spent on similar types of activities under the manual system.

Unfortunately, the second conclusion drawn from AFSOS operations at Seymour Johnson AFB is that the accountant's role required more work than during manual operations for access control, report spooling, and security system operations. These items alone account for 42% of the accountant's time at the test site. Therefore, it appears all the AFSOS-related tasks were left to be performed by the accountant and were not partially assumed or distributed among several positions. For example, the Superintendent was to have sole responsibility for security system operations. However, these duties, which included security system updating and checking and auditing access control reports, were delegated to the accountant.

In addition, and perhaps more importantly, whenever any of the food service personnel at the base had a question of AFSOS, they would invariably call the accountant, as he was considered to be the resident expert on site. Further, as new people were assigned to food services, there was a natural tendency to call the accountant when problems arose instead of reading the Users Manual--and that further aggravated the problem. While this is a negative finding, it points out the need to have more people share in the responsibility of automated system operation.

Storeroom Personnel. AFSOS had a major impact on the job functions of storeroom personnel. The percentages of time spent in these functions is presented in Table 7 for the pre- and in-test data collection periods. During

TABLE 7. Work Sampling Analysis of Storeroom Personnel (Percentage)

Function	Pretest	In-test
Supply (review, count, check, restock shelf)	27	22
Picking Up & Delivering Supplies	10	2
Form Preparation	39	21
Administration and Supervising	4	8
AFSOS File Maintenance & Inventory Updating	0	24
Inventory Reconciliation	0	8
Nonproductive Activities	20	15
Total	100%	100%

the test, these individuals spent 18% less time preparing food service forms than they did before the test. Some reduction in this activity was anticipated since AFSOS generates food service forms automatically. There was also a marked decrease in the time spent picking up and delivering supplies. In an earlier section, it was pointed out that AFSOS provided a tool whereby the level of inventories was reduced. Hence, there were fewer supplies to pick up. This is probably the result of better ordering and fewer run outs, thereby reducing the necessity to make special trips to the Commissary.

The time spent on productive activity was 80% under the manual system and 85% under the AFSOS operations, indicating that the level of effort required is comparable under either the manual or the automated operations. It can be argued, however, that efficiency under the automated system is higher than under the manual operations. With the AFSOS technology, more time is spent on checking and maintaining accurate inventory levels and less time adding and subtracting numbers required in maintaining a manual card inventory. In fact, the 18% reduction in the amount of voluminous paperwork was effected by AFSOS, even though a considerable amount of time is required to input the volumes of data to detail the quantity of each ingredient required and actually used for each meal.

Cooks. Before the implementation of AFSOS, the cooks and one clerk spent 4% of their time on manual paperwork. During the test, this figure was reduced to approximately 1.5%, which includes terminal time during the test. There were 10 cooks; and assuming each worked 40 hrs/wk, a total of 400 hours would be worked. While the magnitude of the reduction is not great, this means a 2.5% reduction is a one-hour reduction per worker per week, which, while not significant, is a positive sign.

Shift Leaders. There seemed to be a slight increase in the amount of time spent on paperwork by the shift leaders. However, it must be remembered that during the test effort, the paperwork activities and AFSOS activities were combined. For example, the production log is only partially automated, so shift leaders still have to manually complete some portions of this form. The slight increase was due to the requirement for the shift leaders to initiate and terminate the real time access control operation at the cash register for each meal period. A more detailed review of the specific paperwork functions performed indicates that there is no real increase or reduction in the amount of time spent on paperwork functions.

There is, however, one dramatic example of time savings in the AFSOS operation. A long-range forecast is required to determine the ingredient requirements for the main dining facilities. This would typically be accomplished by a shift-leader-level person and would require approximately 36 hours. In addition, a dining-hall-manager-level individual would be required to review the raw food requirements in detail, and this would require approximately 12 hours. These raw food projections are generated for use by the commissary, so that the commissary will be able to order in advance the necessary food for the dining facility. These forecasts are generated every 90 days and are prepared in 30-day increments.

The AFSOS has a Projected Ingredient Requirements Program to automatically generate this long-range, raw food requirement. Therefore, the 36 hours typically spent by a shift leader are virtually eliminated. Further, the 12 hours typically spent by a dining hall manager in a detailed review and modification of the raw food requirements are reduced considerably, as the dining hall manager would in all likelihood only have to make some minor ingredient changes, if in fact any modification was required at all.

Dining Hall Manager. The functions of the dining hall manager and the food service superintendent were virtually unchanged under the AFSOS operations. Functions such as planning, motivation, and control are performed whether the management information system is manual or automated. As noted in the above paragraph, however, the time required to perform these functions is redistributed. Where reviewing long range forecasts used to be a 12 hour task, the time to perform this task was considerably reduced by the AFSOS system.

Summary of Air Force Personnel Attitudes

Data were collected in June 1982 from Air Force food service personnel at Seymour Johnson AFB to record perceptions of AFSOS prior to its introduction. Fifteen cooks, eight administrators and two storeroom personnel were interviewed. Data were again collected in January 1983, after the introduction of AFSOS, from four storeroom personnel, two shift leaders, one accountant, one office clerk, two dining hall supervisors and one assistant dining hall supervisor. The individuals in the in-test survey were identified as primary users of the system.

Usefulness of AFSOS. Expectations of the ability of the new system to "improve your ability to perform your job" were high (96%). After the introduction of the system, 82% of the primary users agreed that it had improved their ability to perform their jobs. The percentage of respondents agreeing to the usefulness of AFSOS in specific areas is presented in Table 8.

As can be seen, high expectations of AFSOS were most uniformly confirmed by later experience. There were three instances where the high expectations of AFSOS were not completely confirmed by later experience. The first instance involved making long-range forecasts for the commissary. The AFSOS system utilized a Durango microprocessor on which a considerable demand was placed. Unfortunately, the Durango microprocessor was perceived as being slow, and due to this the long-range forecasting procedure was not used as often and effectively as it could have been. The second instance involved generating orders for the commissary. During the test effort there were many menu changes but the automated system was not always updated to reflect these changes. Therefore, orders were not always accurate, because ingredients to be ordered did not reflect what was to the served. This required food service personnel to manually update orders, thus reducing the effectiveness of the ordering procedures. Finally, the third instance involved detecting theft/fraud by workers. Food service personnel seemed to believe that as they became more knowledgeable on how AFSOS worked, then the system would be beatable, especially if management did not closely review the audit reports.

TABLE 8. Worker Perceptions of the Usefulness of AFSOS

	AREA	June 1982 (N = 25) (Percent YES)	January 1983 (N = 11) (Percent YES)
1.	Predicting headcount	88	90
2.	Determining number of portions to prepare	88	100
3.	Making long range commissary forecasts	87	83
4.	Determining ingredients required when other then 100 portions are to be prepared	87	80
5.	Generating orders	91	62
6.	Updating inventories	100	100
7.	Inventory reconciliation	100	100
8.	Detecting fraud by customers	83	100
9.	Detecting theft/fraud by workers	79	50
10.	Generating reports	96	100
11.	Updating	100	100
12.	Completing the final senior cook requisition	*	91
13.	Completing the final Air Force Form 287	*	90

* Not asked

TABLE 9. Arrival and Service Rates at the Cash Register Stations

	Pre Test		In Test	
	Mean	Std Dev	Mean	Std Dev
Arrival Rate				
Breakfast	*	*	31.15	29.90
Lunch-Main	20.72	20.64	23.11	21.70
Lunch-Short Order	27.97	26.16	18.65	20.02
Dinner	*	*	26.67	25.60
Average Service Rate				
SIK customers	14.53	5.49	13.39	4.70
BAS customers	25.58	9.70	22.65	8.09
Average Service Rate by Meal (SIK)				
Breakfast	16.83	5.96	12.85	3.91
Lunch-Main	14.96	5.54	16.42	4.22
Lunch-Short Order	11.78	3.84	12.87	5.49
Dinner	15.75	5.73	13.12	4.17
Average Service Rate by Meal (BAS)				
Breakfast	25.43	12.74	17.85	7.37
Lunch-Main	25.63	8.99	23.47	8.12
Lunch-Short Order	22.38	8.59	25.95	7.50
Dinner	28.59	10.55	22.79	7.64

* No data collected

When asked to report the advantage of the AFSOS, the most common responses were that it saves time, cuts down on paperwork, and is more accurate. Two individuals reported that it was also educational, in that computer skills were being learned.

Anticipated and Reported Problems. When asked to anticipate problems associated with the introduction of AFSOS, half of the sample expressed concern that people would not be properly trained to operate the system. System breakdown was also considered by a large number to be a possible problem.

The most frequently reported problem was Decwriter breakdown. This problem was more with the service contract than with the equipment. A newly purchased maintenance arrangement is expected to take care of this problem. Several users also reported that the system was too slow. This is a function of using an 8-bit microprocessor to handle a heavy time-sharing load. Upgrading to a 16-bit processor would remove excessive delay. Two individuals also indicated that more people should be trained to be proficient with the system.

Electronic Cash Register Operations

While it is clear from the prior customer survey results that AFSOS was accepted, there is still the question of whether the real-time access control procedures impose an additional delay at the cash registers. Results pertinent to this question are presented below.

As shown by the data summarized in Table 9, the ECR's were as fast or faster during the test using the magnetic stripe card readers, when compared to the pretest situation where a paper meal card was carried and the cashier merely input the six-digit meal-card number and performed no real validation checks on the SIK status of each card holder. The average service rate for the ECR's is defined as the time from when a person actually arrives at the ECR to be processed (but does not include the time waiting in line) to the time when the individual leaves the ECR. The average service time actually went down from 14 to 13 seconds when the customer was using a magnetic stripe meal card. In addition, the average service rate when the customer was paying cash also went down from 25 to 22 seconds.

Simulation of ECR Queues. A simulation of the electronic cash register operations was prepared to determine the effect of using the magnetic stripe card reader on service line rates as well as on the length of the queue at the ECR station. To conduct this simulation, arrival and service rate data were collected during each meal period at the main dining facility prior to and during the test effort. The arrival rate data collected was the mean time between arrivals to the queue, if one existed, at the ECR. The service rate data collected was the total processing time of the ECR per person not including the time spent waiting in line. This time was defined as the time spent from initial arrival at the ECR, when the cashier begins to ring up the sale until the sale is complete and the customer may walk away from the ECR. The service rate data was further separated into two categories: customers with meal cards and customers paying cash.

TABLE 10. Electronic Cash Register Simulation Results (headcount)

	Mean Length of Queue
Pretest Arrival, Pretest Service Rates	
Lunch-Main Line	2.77
Lunch-Short Order Line	2.23
In-test Arrival, In-test Service Rate	
Lunch-Main Line	1.47
Lunch-Short Order Line	4.32
Pretest Arrival, In-test Service Rate	
Lunch-Main Line	2.85
Lunch-Short Order Line	2.03
In-test Arrival, Pretest Service Rate	
Lunch-Main Line	1.48
Lunch-Short Order Line	4.04

The results of the ECR simulation are displayed in Table 10. During the test there was a significant increase in the length of the queue at the short-order line ECR. The mean service rate of the short-order line ECR, however, only increased slightly as shown in Table 9: from 11.78 to 12.87 seconds for customers with a meal card and from 22.38 to 25.95 seconds for customers paying cash. Moreover, the mean time between arrivals at the short-order ECR decreased from one customer arriving every 27.97 seconds prior to the test to one customer arriving every 18.65 seconds during the test effort. There were many exercises conducted during the test effort which increased the headcount considerably. This data shows that the increase in headcount resulted in a pronounced increase in the demand on the short-order line. Note that the mean queue for the lunch main line decreased, which was also due to a slight reduction in the demand at this ECR station. A detailed review of the ECR simulation table indicates that given the pretest arrival and the in-test service rates, the mean length of the queue for the main and short order lines remains relatively constant when compared to the queues for pretest arrival and pretest service rate. However, given the in-test arrival rate and the pretest service rate, the queue for the lunch short order line increases dramatically when compared to the pretest arrival and pre-test service rate--further reinforcing the fact that the length of the queue at the ECR stations during the test effort was due to increased customer demand and not on the speed of ECR operations.

ECONOMIC ANALYSIS

An economic analysis of AFSOS was prepared to determine the economic feasibility of the system. According to the "Economic Analysis Handbook," the maximum economic life for Automatic Data Processing equipment is eight years. The fixed costs of the AFSOS equipment are listed in Table 11. Note that the AFSOS computer system equipment listed in Table 11 will certainly be required. However, the meal card production equipment will not be required since the new DoD ID card will be used in lieu of the magnetic stripe meal card. In this case the magnetic stripe card readers in the dining facilities would read the DoD ID card and verify the person's SSN against the central meal card file in the main computer. When a new person arrives on base, instead of obtaining a meal card from his squadron, he would have his squadron notify the staff office to input his SSN and other pertinent information into the central meal card file. Therefore, this meal card production equipment would not be required in this scenario, and this cost will not be included in this analysis.

The fixed costs that were included in this economic analysis include the cost of the microcomputer located in the food service staff office, the electronic data terminals in the dining facility storerooms, the electronic cash registers and magnetic stripe card readers placed on the serving lines in the dining faciiities as well as the communications equipment required for real time processing. The cost of this equipment is $51,252.

TABLE 11. AFSOS Fixed Costs

I. AFSOS Computer System	Cost
1 Microcomputer (Durango F-85) *	$15,000
4 Electronic Cash Registers (Data Terminal System Model #521)*	$27,032
2 Electronic Data Terminal (Decwriter III's) $ 5,000	
Communications equipment Modems (Com-Data 202T)	$ 2,012
RS 232 Cables/A-B Switches	$ 670
Autocalling Unit/2025 modem	$ 1,538
SUBTOTAL	$51,252
II. Meal Card Production Equipment	
Camera equipment and magnetic stripe meal cards	$11,482
Meal card embosser	$13,929
Meal card tipper	$ 703
SUBTOTAL	$26,114
GRAND TOTAL	$77,366

* Not counting a discount of as much as 40% when purchased in quantity from the GSA Schedule.

The annual costs of operating AFSOS are presented in Table 12 and includes maintenance for AFSOS hardware, supplies such as floppy diskettes, and computer paper. The annual cost is $10,111.

The quantifiable benefits of AFSOS documented at Seymour Johnson AFB are displayed in Table 13. These quantifiable benefits calculated in Table 14 include a reduction from 23% to 1% in questionable meal card use and inaccurate headcount records (refer to Table 3) saving $101,768, reduced inventory levels from $12,269 to $10,306, saving $1,963, and a reduction of the time spent preparing a long range forecast from 48 to 6 hours saving $1,143 annually.

The cost analysis presented in Table 13 shows that AFSOS generates a cost savings over the expected life (8 years) of the system. As shown in Table 13, the present value of the annual reduction of food service system costs is $586,980 which is generated by lower meal card abuse, lower inventory levels, and reduced labor for computing future food ingredient requirements for the Commissary. This is partially offset by the increased costs resulting from equipment purchase and annual maintenance and supply costs. Overall, a net present value of $479,136 in savings results from the implementation of AFSOS. Further, as shown, AFSOS is cost effective even when only considering the cost savings that were quantifiable in this limited evaluation. For example, the AFSOS assisted food service personnel in controlling food costs. If food savings are achieved, however, instead of direct cost savings resulting, the staff modifies the menu to serve more expensive food items so that on average the full Basic Daily Food Allowance is expended. This is a direct benefit to the airmen since a more expensive and higher quality food item like steak is served. However, it does not result in a quantifiable cost savings; and therefore, it is not included in this analysis.

The most important point is that AFSOS is cost effective even when limited only to the quantifiable cost savings and not including the myriad of benefits also directly related to AFSOS.

TABLE 12. AFSOS Variable Costs

Annual Costs

Maintenance Cost		$Amount
Microcomputer		$4,200
Electronic Cash Registers		$2,705
Electronic Data Terminals		$ 720
Subtotal Maintenance Costs		$7,624
Supplies		
Floppy Diskettes	365 @ $4.28 =	$1,562
Paper		$ 925
Subtotal Supplies		$2,487
GRAND TOTAL		$10,111

TABLE 13. AFSOS Economic Analysis: Present Value of AFSOS Costs and Savings

Costs	Present Value
Equipment Purchase	$ 51,252
Annual expenditure for supplies = ($10,111) x (5.597)* =	$ 56,592
Total Present Value of Costs	$107,844
Savings	
Annual reduction of expenses** = ($104,874) x (5.597)* =	$586,980
Total Present Value of Savings	$479,136

* = Present value factor of a cumulative uniform series
** = See Appendix A

TABLE 14. AFSOS Quantifiable Annual Cost Savings

1. Cost savings resulting from a reduction from 23% to 1% in the rate of questionable signature sheet entries and inaccurate records:

(Meals)	Fewer Meals Provided at GOV'T Expense (Percent)	Cost Per Meal (Dollars)	Annual No. of Meals Served (Dollars)		Dollar Savings
BRK	22	(0.2)(3.57)	(175)(365)	=	10,033
LUN	22	(0.4)(3.57)	(347)(365)	=	39,790
DIN	22	(0.4)(3.57)	(325)(365)	=	37,267
MIDNT	22	(0.4)(3.57)	(128)(365)	=	14,678
TOTAL					$101,768

2. Cost savings due to reduced inventory levels:

	($ Value of Inventory Reduction)	X	(Amount of Inventory Reduction)		
TOTAL	$12,269		(0.16)	=	$1,963

3. Cost savings of long range forecasting:

Level		Hours Reduced		Composite Hourly Rate		
E5	Shift Leader	36 Hours	x	8.60	=	$ 310
E7	Dining Hall Manager	6 Hours	x	11.84	=	$ 71
TOTAL						$ 381

4. Annual cost savings:

	(Long-Range Forecast Cost Savings)	X	(3 Long-Range Forecasts per year)	
=	($381)	X	(3)	= $1,143

5. Total annual cost savings = $104,874

CONCLUSIONS AND RECOMMENDATIONS

The test of AFSOS conducted at Seymour Johnson AFB clearly indicates that automation in Air Force food services is feasible and cost effective. There were quantitative and qualitative benefits derived from AFSOS. The pre and in-test data collected indicates that a significant reduction in meal card abuse (from 23% to 1%) and inventory ingredient storage requirements from 12K to 10K) results which significantly reduces the cost of Air Force food services operations. In addition, many other benefits are derived from AFSOS. These more qualitative benefits result from the fact that AFSOS permits the redistribution of time up to 18% in some instances of food service personnel so they can perform more useful tasks. For example, food service personnel under AFSOS spend more time checking and verifying to ensure a controlled, well managed operation, while spending less time on manual calculations and report preparation. Further, AFSOS decreases inventory wastage which allows highly desirable but expensive food to be served at the same Basic Daily Food allowance rate which enhances the quality of Air Force food services in general.

The economic analysis of AFSOS implementation at Seymour Johnson AFB indicates that AFSOS is cost effective. The AFSOS system addresses the problem areas in military food services as cited by the Defense Audit Service and General Accounting Office audits. Considerable annual savings accrued from the access control/automated headcount ($101,768), inventory ($1,983), and report preparation functions ($1,143) automated by AFSOS which were cited as deficiency areas by the DAS and GAO audits. It is, therefore, recommended that the Air Force implement the automation of food services on a world wide basis. Further it is suggested that AFSOS be incorporated into the Air Force Services Information Management System (SIMS). This recommendation merely supports current plans. In fact, Natick R&D Center personnel have already provided assistance to the Air Force in their design of the elements of the SIMS system. The SIMS system will be implemented on a minicomputer of at least 16 bit architecture. This will alleviate one of the problems inherent in the AFSOS hardware which uses an 8 bit microcomputer. The AFSOS utilized an 8 bit computer with a BASIC interpreter which many people perceived as being too slow. The implementation of the SIMS system on a 16 bit computer with a compiler should increase the system response time. Further, it would be desirable to more effectively utilize video display units to minimize the rate of paper usage in the dining facilities where only a printer was available. The Air Force should also consider placing two terminals in the large dining facilities to permit more people to have access to the system. Finally, care should be taken to insure that the additional responsibilities of AFSOS will be evenly distributed to appropriate food service personnel to minimize the burden on any one individual.

It is also recommended that the SIMS system utilize many of the automation routines utilized by AFSOS. While the AFSOS hardware (i.e. 8 bit architecture) was very limiting, the software written to over come these limitations was refined considerably during the system test at Seymour Johnson AFB. As a result, there are many nuances and specialized routines

incorporated into the design which at face value do not appear important but which increase system speed dramatically. Therefore, it is recommended that the AFSOS operating procedures be incorporated to the maximum extent possible into the SIMS system.

Finally, it is recommended that the Air Force continue to advance the state of the art of food service automation by considering the use of electronic signatures in order to eliminate the need for maintaining hard copies of some reports with authorized signatures.

LIST OF REFERENCES

1. Air Force Regulation 146-7, "Food Service Management," 16 February 1982.

Appendix

Pre and In-Test Data Collection Forms

APPENDIX

Pretest and In-Test

JOB ACTIVITY DIARY

I. Specific Job Activity

Code	Description
01	Preparation. The obtaining, mixing, cutting, chopping, etc., of all ingredients used for salads, meat, and vegetable production. The general preparation of all food products.
02	Cooking. All actual activities involved in the art of cooking. For example, selecting proper temperature setting, monitoring food being cooked or reconstituted, seasoning, placing and removing food from containers, and cooking food on grill or oven.
03	Serving. This activity is related to activities associated with the serving line outside the purview of cooking. These include plating meals, setting up and breaking down serving line, and replenishing the line. This also includes the time spent in position ready to serve, even though there are no customers.
04	Sanitation. This encompasses all aspects of cleaning, trash disposal, and sanitation in all food service areas. For example, dishwashing, pot and pan washing, the placing of these wares into their proper receptacles, and equipment sanitation.
05	Supply. This includes the movement of supplies from the storage area as well as receiving, unpacking, etc., of these supplies from outside sources. All inventory manipulation, internal issuance of supplies, and replenishment of all beverage equipment.
06	Administration. This includes the drafting and typing of correspondence and the maintenance of civilian employee personnel and pay records. This category includes answering the telephone and paging personnel as well as changing menu boards for upcoming meals. This does not include supply a demonstration or report preparation.
07	Maintenance. Preventive or corrective maintainance done on any piece of equipment necessary for the completion of the food service mission. This category includes Burner Maintenance.

Code	Description
08	On the Job Training. This task involves knowledge and/or skills being taught to an individual in a planned, structured manner, The observer should look for demonstrations, explanations, practice sessions, and self-instructional activities.
09	Supervision. This includes review of the present system by the Supervisor in procedures and methods, as well as inspection and monitoring of food service areas/personnel, including giving instructions.
10	Traveling. This includes driving or being in transit from one work location to another.
11	Picking Up/Delivering Supplies. This includes the acquisition of supplies which may include food or expendables (paper products, office supplies, etc.) for use at the work location.

Code	Description	
	Report Preparation This includes the preparation of all reports and records itemized as follows:	
21	AF Form 85	Inventory Adjustment Voucher
22	AF Form 129	Tally In/Out
23	AF Form 147	Dining Hall Stock Record
24	AF Form 148	Senior Cooks Requisition
25	DD Form 160	Inventory of Class () Quartermaster Supplies
26	AF Form 249	Food Service Operations Report
27	AF Form 287	Subsistence Request
28	AF Form 467	Monthly Summary of Flight/Special Feeding
29	AF Form 662	Food Service Production Log
30	AF Form 1119	Monthly Monetary Record
31	DD Form 1131	Cash Collection Voucher
32	AF Form 1650	Daily Dining Facility Summary
33	Other Forms	
40	Other This includes breaks and other nonwork periods (lunch time, time in bathroom, etc.) and all other nonwork activities not defined elsewhere.	

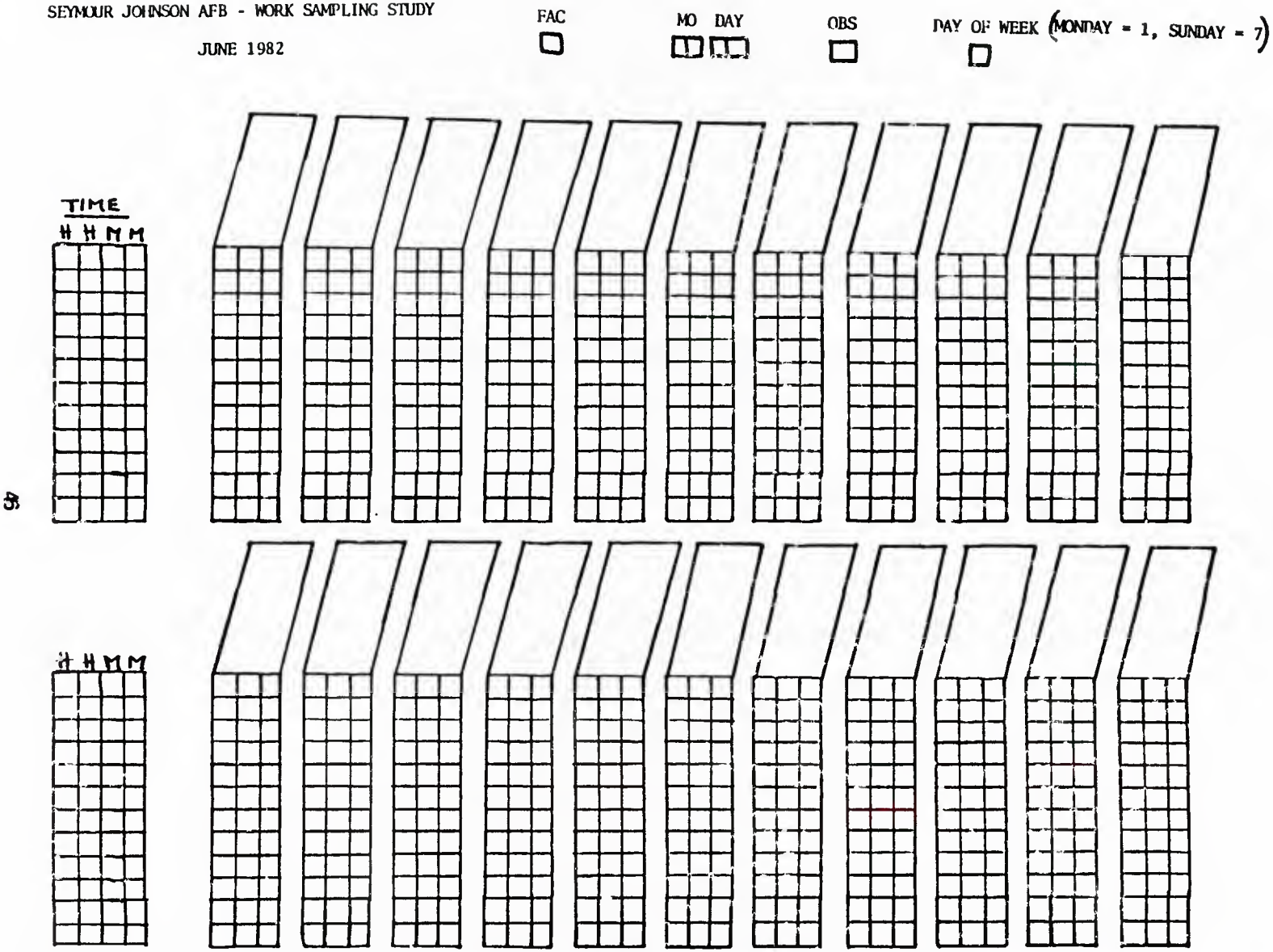

Figure A-1. Pretest Work Sampling Data Collection Form

JOB ACTIVITY DIARY

DATE _____ WORK LOCATION _____

TIME (15 MIN)	JOB CATEGORY 1	2	3	TIME (15 MIN)	JOB CATEGORY 1	2	3

	CODE (COL.1)
AT WORK LOCATION	1
AWAY FROM WORK LOCATION	2

ACTIVITY	CODE (Col.2&3)
Preparation	01
Cooking	02
Serving	03
Sanitation	04
Supply	05
Administration	06
Maintenance	07
OJT	08
Supervising	09
Traveling	10
Picking Up Supplies	11
Report Prep - AF 85	21
- AF 129	22
- AF 147	23
- AF 148	24
- DD 160	25
- AF 249	26
- AF 287	27
- AF 467	28
- AF 662	29
- AF 1119	30
- DD 1131	31
- AF 1650	32
- Other Forms	33
Other	40

Figure A-2. Pretest Job Activity Diary Data Collection Form

ECR- SERVICE RATES

DATE _____ DINING FACILITY _____ MEAL _____

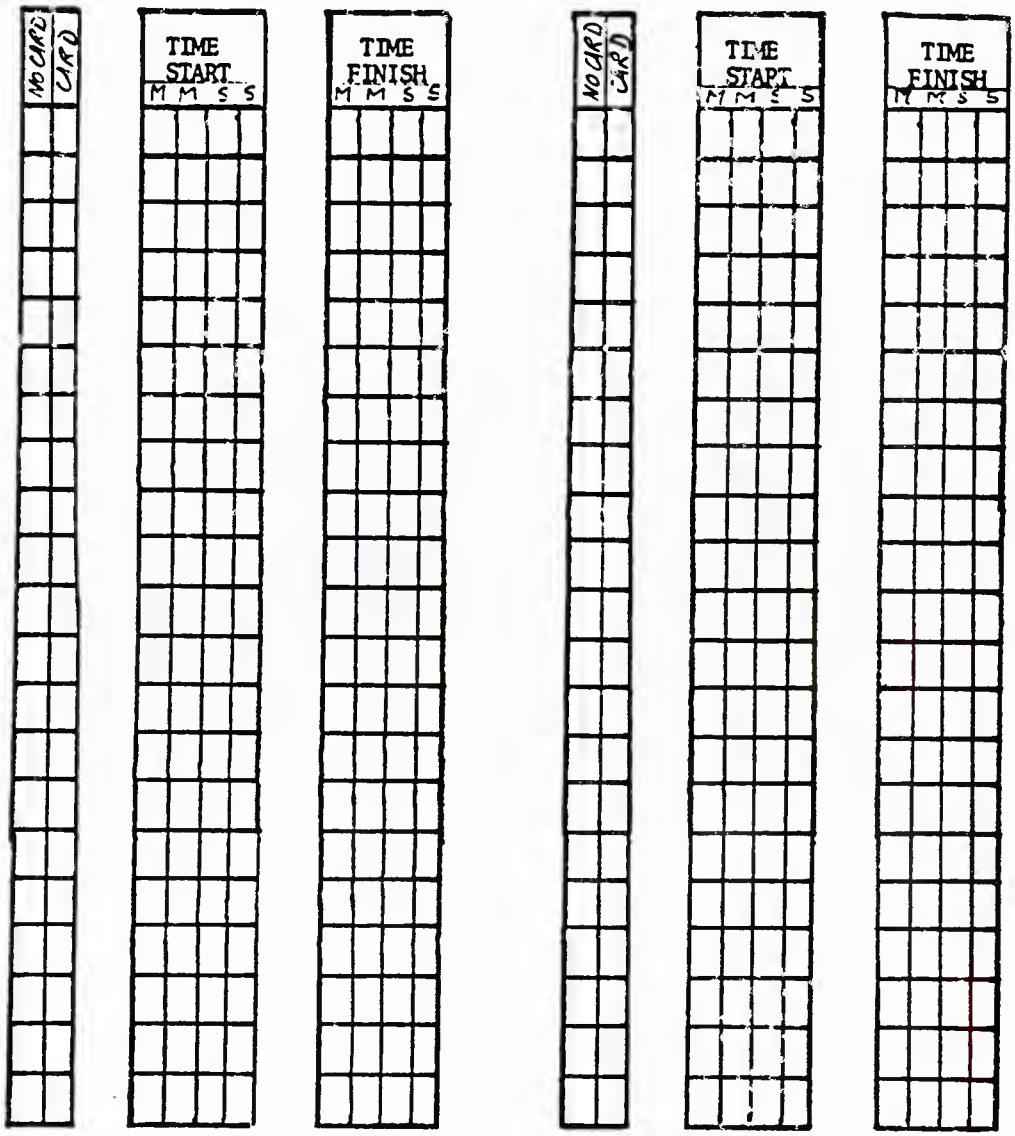

Figure A-3. ECR Service Rate Data Collection Form

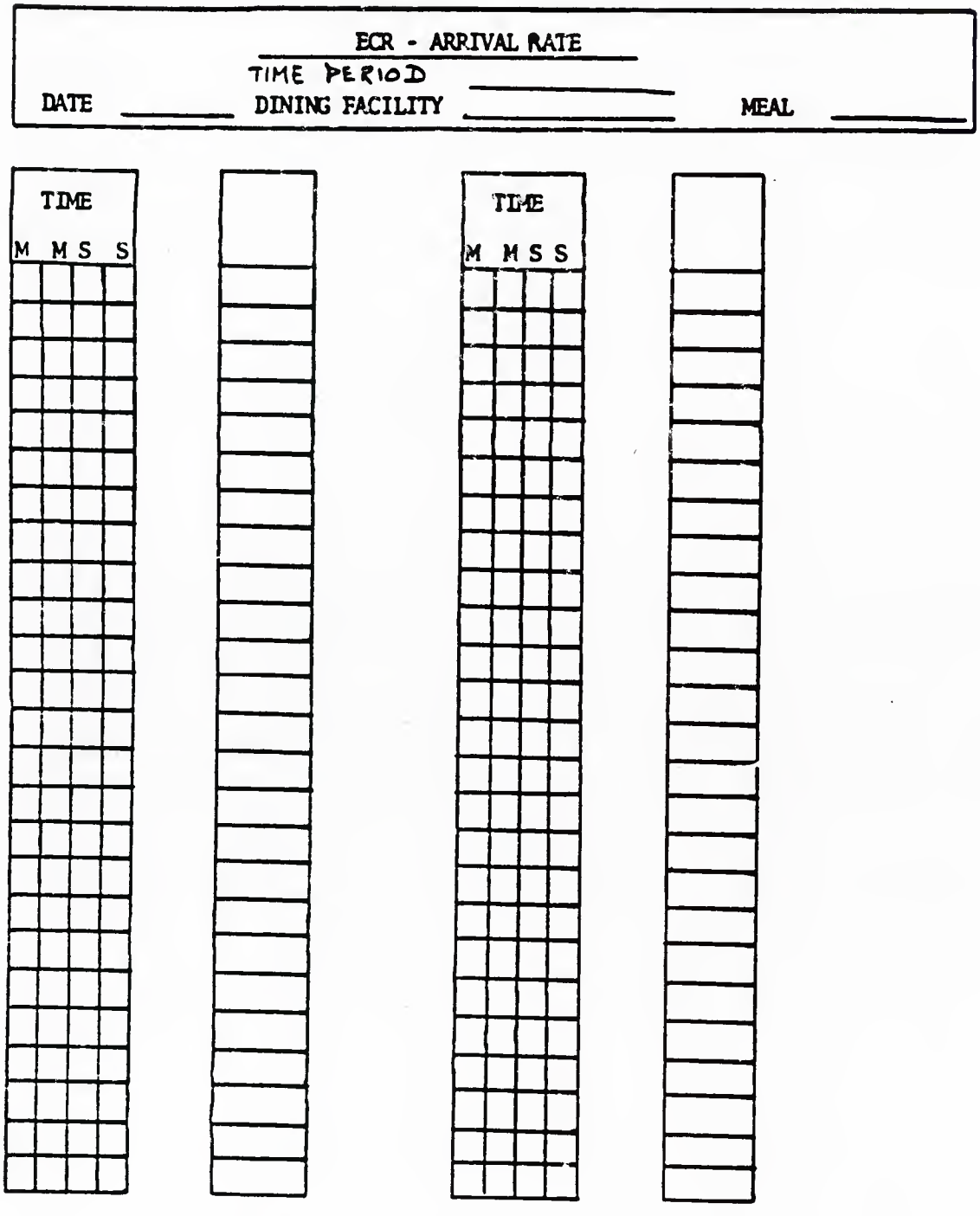

Figure A-4. ECR Arrival Rate Data Collection Form

JOB CLASSIFICATION	CODE (Col. 1)	ACTIVITY		CODE (Col. 2&3
Food Service Ofcr.	1	Preparation		01
F.S. Superintendent	2	Cooking		02
F.S. Accountant	3	Serving		03
D.H. Supervisor	4	Sanitation		04
Shift Leader	5	Supply		05
Cook	6	Administration		06
Clerk	7	Maintenance		07
Storeroom Person	8	OJT		08
Cashier	9	Supervising		09
		Absent		
		- Picking Up Sup		11
		- Del/Serv. Food		12
		Other Productive		13
		AFSOS-ACTIVITY		
		Accounting	Updating	21
			DD 1131	22
			AF 1650	23
			FLT KIT AF 467	24
			AF 1119	25
			AF 249	26
		File Maintenance	HDCT/Sel Ratio	31
			Menu	32
			Master SIK	33
			Ing/Inv	34
			Recipe	35
		Forecasting	Headcount	41
			Selection Ratios	42
		Menu Production	Senior Cooks Req's (pre/post)	51/52
			Production Log	53
			Rec. Ing. Req. Rept	54
			Menu	55
		Access Control	Meal Time	61
			After Meal	62
			Update Master SIK file	63
			Consumer info/meal rept	64
		Inventory	287 (pre/post)	71/72
			Reconciliation	73
		Report Prep	Newswriter	81
			Spooler	82
		Other Computer Time		91
		Other Manual Forms		92
		Non Productive		99

Figure A-5. In-test Work Sampling Job Classification/Activity Codes

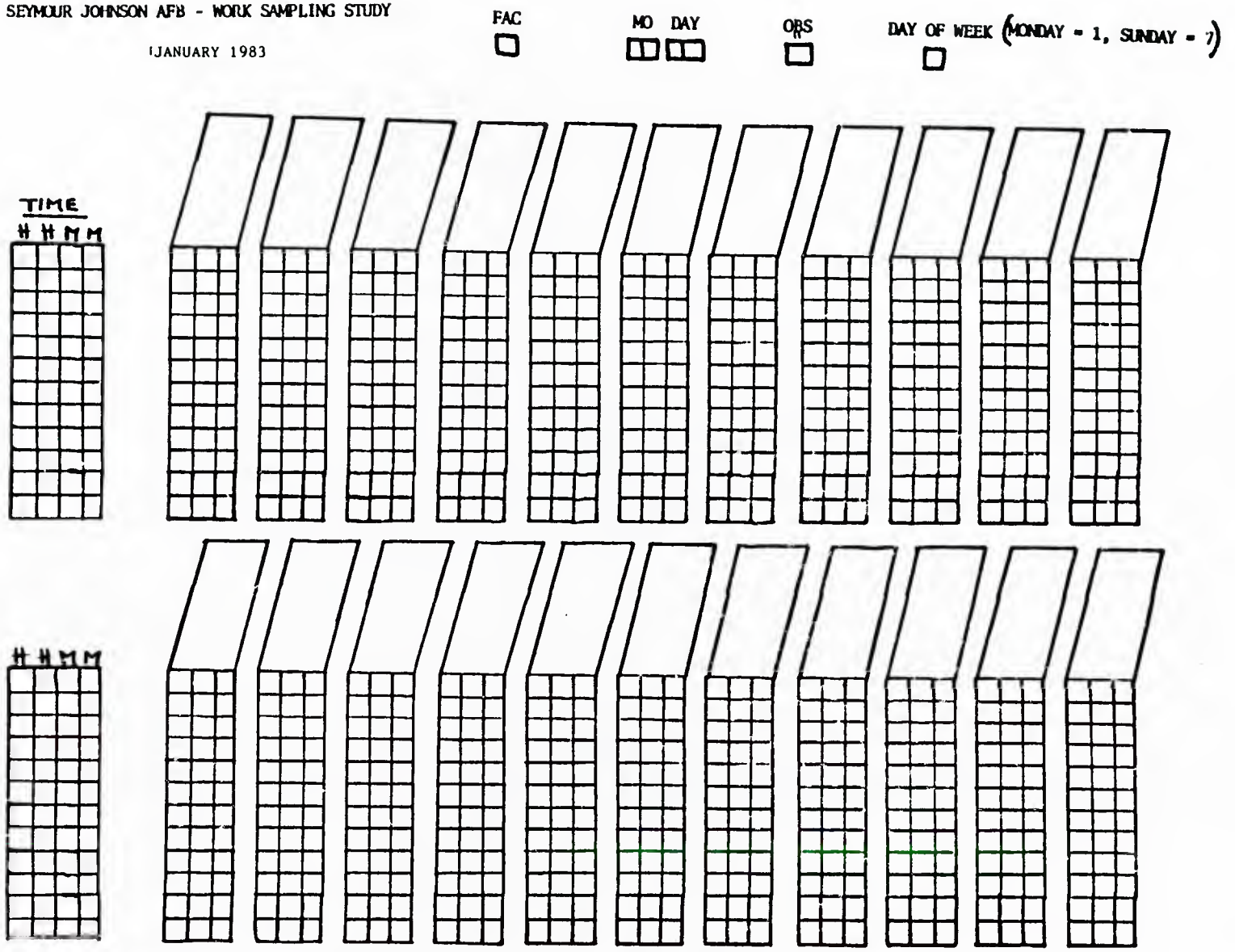

Figure A-6. In-test Work Sampling Data Collection Form

JOB ACTIVITY DIARY

DATE _____ WORK LOCATION _____

TIME (15 MIN)	JOB CATEGORY 1	2	3	TIME (15 MIN)	JOB CATEGORY 1	2	3

	CODE (COL.1)
AT WORK LOCATION	1
AWAY FROM WORK LOCATION	2

ACTIVITY		CODE (Col. 2&3)
Preparation		01
Cooking		02
Serving		03
Sanitation		04
Supply		05
Administration		06
Maintenance		07
OJT		08
Supervising		09
Absent		
- Picking Up Sup		11
- Del/Serv. Food		12
Other Productive		13
APSOS-ACTIVITY		
Accounting	Updating	21
	DD 1131	22
	AF 1650	23
	FLT KIT AF 467	24
	AF 1119	25
	AF 249	26
File Maintenance	EDCT/Bal Ratio	31
	Menu	32
	Master STK	33
	Inq/Inv	34
	Recipe	35
Forecasting	Headcount	41
	Selection Ratios	42
Menu Production	Senior Cooks Req'S (prv/post)	51/52
	Production Log	53
	Rec. Log, Req. Rept	54
	Menu	55
Access Control	Meal Time	61
	After Meal	62
	Update Master STK File	63
	Consumer Info/Meal rept	64
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Figure A-7. In-test Job Activity Diary Data Collection Form

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